SUCCESSFUL USE OF WOODEN ROOF BOLTS IN STONY POINT MINE, STONY POINT COAL CO., HOPKINS COUNTY, KY.

BY L. W. KELLY

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L. W. Kelly[1]

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[1] Mining engineer, Accident Prevention and Health Division, Region VIII, Bureau of Mines, Vincennes, Ind.

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SUMMARY

The purpose of this circular is to show that, under the conditions prevailing in the Stony Point mine, wooden bolts were just as satisfactory as steel bolts or conventional timbering, with a reduction of approximately 80 percent in cost of material. This one fact alone is enough to justify an experiment with wood. This circular will show that production records have remained constant with both wooden and steel roof bolts.

INTRODUCTION

The successful use of steel roof bolts is now an accomplished fact in the coal industry, but the use of wooden bolts in place of steel is a rarity. The first experiment with wooden roof bolts was made in 1949 in the Rio Verde mine, Norton Coal Corp., Nortonville, Ky.[2] This experiment was successful; the company obtained excellent results, but operations in the mine were suspended before enough time had elapsed to prove the value of wooden roof bolts conclusively. It is obvious that, if wooden roof bolts could be used in place of steel bolts or conventional timbering methods, every mine operator would use wood, as the cost is only a fraction of the other two methods. The Stony Point experience has proved conclusively that, under certain conditions and with a certain type of roof, wooden roof bolts can be used successfully.

ACKNOWLEDGMENT

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GENERAL INFORMATION

The Stony Point mine is in Hopkins County, Ky., approximately 6 miles southwest of Providence, Webster County, Ky. The mine was opened in 1949, and the use of roof bolts was begun a few months thereafter. It was opened by three drifts in the Kentucky No. 9 coal bed, which averages 60 inches in thickness. The maximum cover is about 120 feet. The fan is operated blowing; one drift is the intake airway, and the other two are returns. One return airway is used as the main belt entry and the other for transporting supplies into the mine and as a manway. The mine is trackless, and the coal is transported by shuttle cars and belt conveyors. All of the coal is undercut to a depth of 7 feet, loaded mechanically, and blasted with permissible explosives. The room-and-pillar method of mining is followed, and the pillars are not extracted. The entries are driven in sets of five, 14 feet wide on 45-foot centers. The rooms are driven 24 feet wide on 42-foot centers. In all, 129 men are employed; of this number, 118 work underground. The average daily production is 3,000 tons of coal.

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[2] Sterling S. Lanier, Jr., Wooden Pins for Mine Roof Control: Am. Min. Cong., Coal-Mine Modernization Year Book, 1950.

CHARACTER OF ROOF AND TIMBERING METHODS

The roof in this mine changes radically from area to area, but a representative section is as follows: Immediately over the coal is a stratum of laminated, hard, black shale, which ranges from 8 to 36 inches in thickness. Above this is a stratum of sandy shale, which averages 6 inches in thickness; this is overlain by 60 inches or more of soft, gray, conglomerate shale known locally as the "kidney bed." As a general rule, the shale falls to the kidney bed, which in this mine forms the main roof (fig. 1).

When the mine was first opened, conventional timbering was used, consisting of 6-inch wooden crossbars or posts set on 5-foot centers. This method of timbering was used for a comparatively short time only.

HISTORY OF ROOF BOLTING

The Stony Point mine was opened late in 1949, and at first the roof was supported by means of conventional timbering - 6-inch wooden crossbars set on 4-foot centers in the entries and three rows of posts set on 5-foot centers in the rooms. In May 1950 it was decided to experiment with roof bolts, and the initial installation consisted of 1-inch, steel, wedge-type bolts in sets of three every 4 feet along the entry. The bolts were 3 feet long and spaced 2-5-5-2. Each bolt was secured by means of a steel plate 6 inches square by 3/8 inch thick. Meanwhile, the roof had changed, and the thickness of the shale lying on the coal ranged from 8 to 36 inches. Above this was about 6 inches of sandy shale and 60 inches of soft, gray shale known locally as the "kidney bed" (fig. 1). The original experiment was successful, and the use of timbers was gradually discontinued. In May 1951, approximately 100,000 steel roof bolts had been used, with no failures. There had been no accidents of any kind from falls of roof in the roof-bolted places, and about 40 tons of coal a shift was mined for each face man. A 12-man crew mined about 500 tons per shift.

In May 1951 studies were made of the material cost of roof bolting, with steel and with wooden bolts. A steel-bolt assembly, which included a 3-foot, 1-inch, wedge-type bolt, a 6-inch-square by 3/8-inch steel plate, and a hexagonal nut, cost approximately $1.00, while it was calculated that a 3-foot wooden bolt with two wooden wedges would cost about $0.20. As a result of the cost differential, it was decided to experiment with wooden bolts. The experimental period lasted about 1 month and was successful. As a result of the knowledge gained thereby, it was decided to use wooden roof bolts in rooms exclusively but to continue using steel bolts in the entries until the wooden bolts had received an extensive trial. This decision was made because the rooms

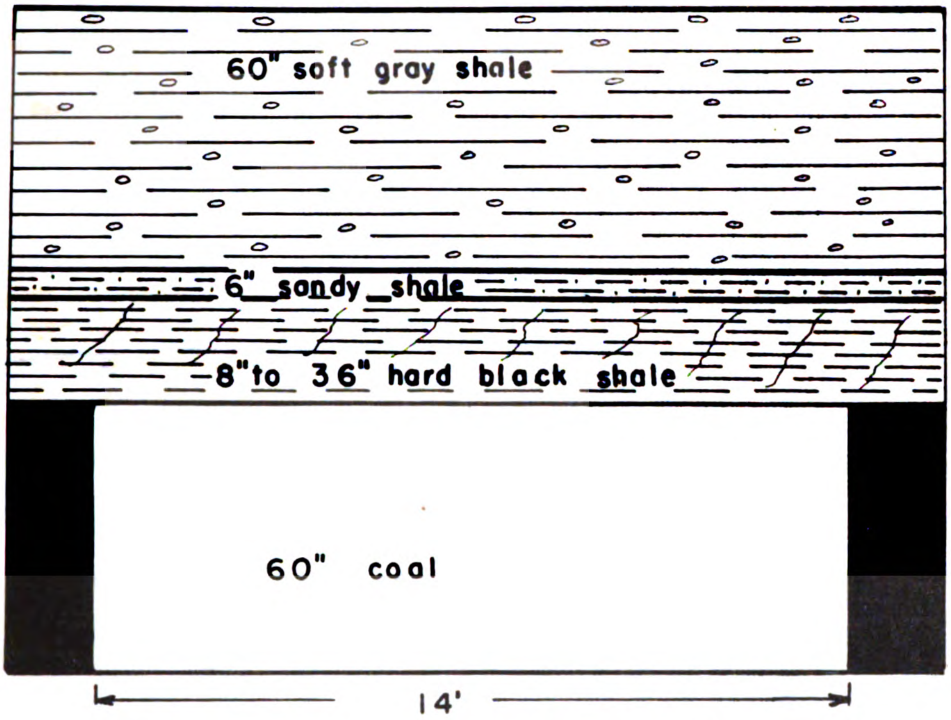

Figure 1. - Representative roof section, Stony Point mine.

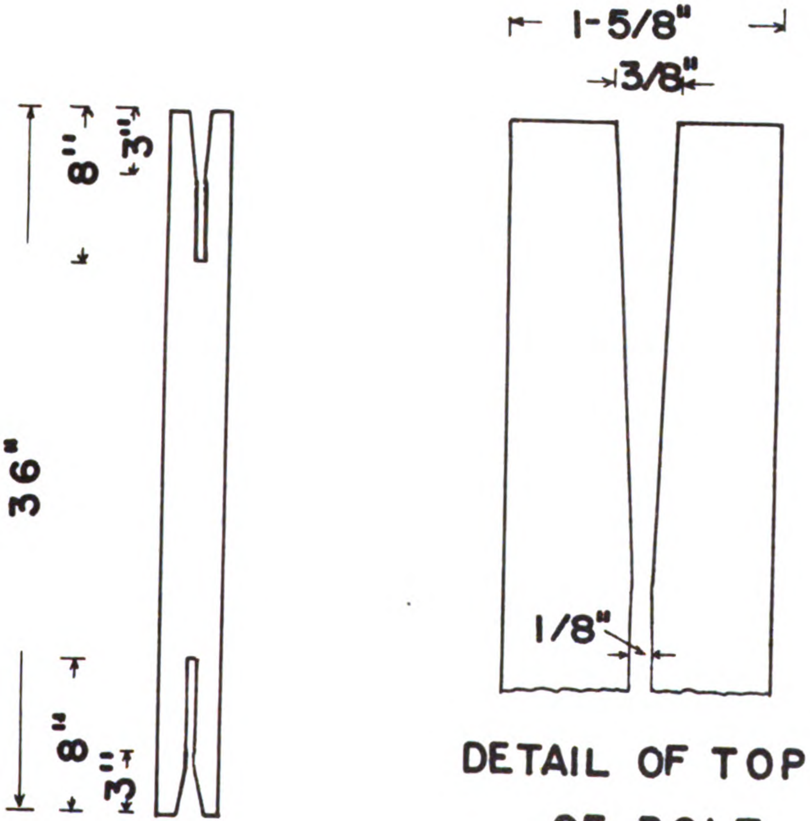

Figure 2. - Sketch of roof bolts used at Stony Point mine.

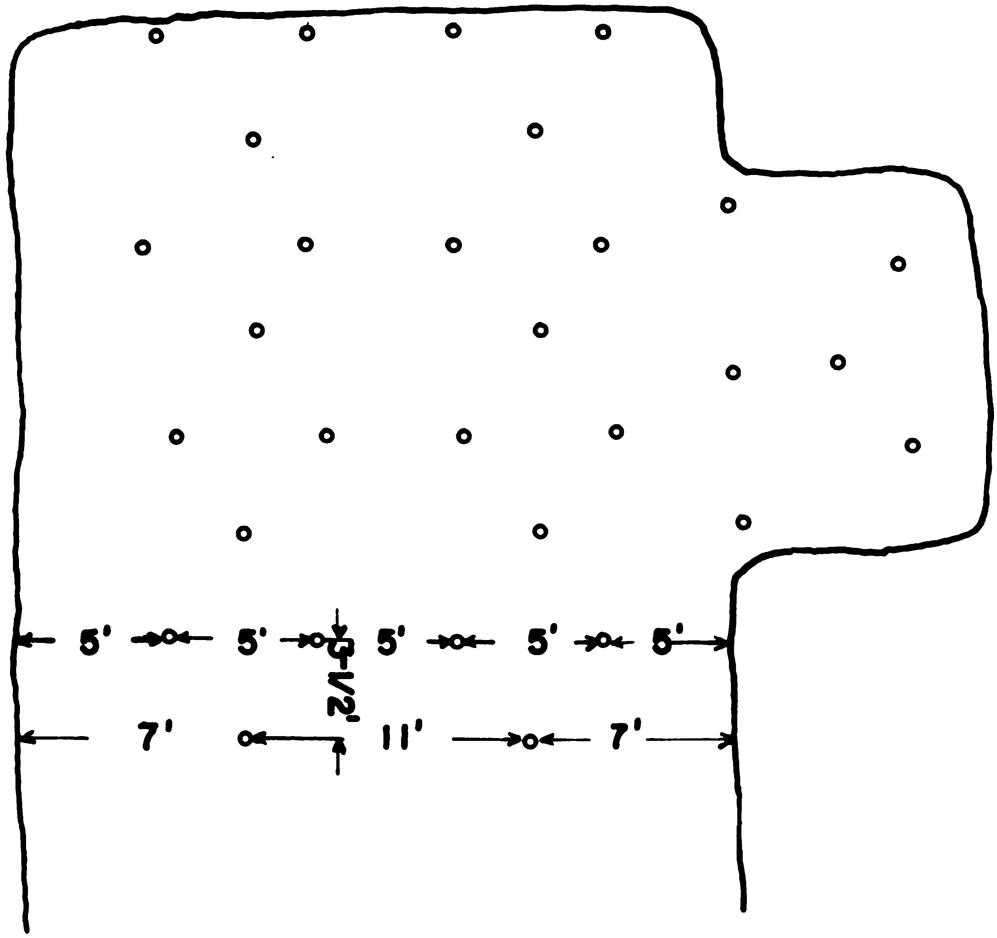

Figure 3. - Roof-bolt pattern at Stony Point mine.
Scale: 1 inch = 6 feet.

were worked out in approximately 12 days, whereas the life of the entries might be several years.

EQUIPMENT

The bolts are made at the mine with a home-made doweling machine and a cut-off saw. The doweling machine consists of one rotating blade and rollers, set so that it will receive a piece of 2-inch-square wood 12 feet long and turn it down to 1-5/8 inches round. The 12-foot length is then cut to 3-foot lengths and a 1/8-inch slot, 8 inches long is cut in each end of the bolt with a cut-off saw. For 3 inches on each end of the bolt the 1/8-inch slot is cut out into a wedge shape which is 3/8 inch wide at the top (fig. 2). The material used is green hickory received at the mine in 2-inch-square by 12-foot lengths. One man can make 500 bolts complete in one shift. Two wedges, made of green hickory wood, 1 inch thick at the butt, 1-1/2 inches wide, and 8 inches long, are used with each bolt. The entire cost of a bolt, including labor and material, is less than $0.20.

To facilitate drilling for the roof bolts and also the face holes for blasting coal, a mobile, rubber-tired truck was constructed on which two drills were mounted. A Jeffrey coal drill is mounted on a post for drilling the horizontal coal holes in the face. A home-made hydraulic drill, raised or lowered by means of a small hydraulic jack, is also mounted on the truck for drilling the vertical roof-bolt holes. This drill has been equipped with the necessary fittings, so that it can be mounted on the cutter bar of a 10-RU mining machine in an emergency. Firthite, 1-3/4-inch, carbide, diamond-shaped bit, is used in conjunction with an auger. After experiments with other kinds and shapes of bits, these have proved most satisfactory.

A 10-horsepower motor drives the truck at an approximate speed of 2 miles an hour. Three hundred feet of No. 2 twin parallel trailing cable is used to supply power to the drive motor.

METHOD OF INSTALLATION

Ordinarily a flexible pattern of seven bolts for each 7-foot cut is used, whereby one four-bolt set is followed at an interval of 3-1/2 feet by a three-bolt set and so on, progressively (fig. 3). This pattern is followed when normal roof conditions prevail; but, if the roof becomes weaker additional bolts are used, and if it gets better than normal a three-bolt, then a two-bolt set is used. If the roof becomes exceptionally bad, posts are used in conjunction with the bolts.

The roof bolts are installed immediately after the loading machine leaves the face and before the mining machine enters. The three-bolt set is installed 3-1/2 feet in advance of the last four-bolt set, and the new four-bolt set is installed at the face of the room. In the crosscuts, which are short and narrow, a total of about six bolts is generally used. As a rule, a crew of two men does the drilling and installs the bolts for both the roof bolts and for blasting in the coal face; sometimes when the bolting and face drilling lags behind the mining cycle crew is increased to three men. The 1-3/4-inch roof holes are drilled first and the bolts installed; then the coal holes, which are also 1-3/4 inches in diameter, are drilled. Ordinarily all of the holes are drilled (seven roof bolts and five coal holes), and bolts are installed in a working place in 15 minutes. As a rule, about 100 roof bolts are installed in a shift. Inasmuch as the mine is operated in three shifts, approximately 300 bolts are installed daily.

The bolts are driven into the holes by sledge hammers. The procedure is as follows: The bolt, with the wedge in place in the upper end, is inserted into the hole and pounded in as far as possible, then the wedge in the outer end is driven home. No plates or blocks have been used with the bolts.

Although the primary responsibility for locating and installing the roof bolts is delegated to the drillers, it is the duty of the foreman of the section to inspect the roof and the bolts between each of the operations in the mining cycle.

In all, 33,910 wooden bolts have been installed; except for two failures, all have been successful.

To show the details of the results of using wooden roof bolts, table 1 is presented.

TABLE 1. - Number of rooms and crosscuts, linear and square feet of roof supported; and number of wooden roof bolts used in Stony Point mine

	No. of rooms and crosscuts	Length, ft.	No. of bolts	Linear ft. of roof supported	Square ft. of roof supported
	18	700	13,200	12,600	302,400
	10	500	4,700	5,000	120,000
	18	300	5,500	5,400	129,600
	12	600	7,400	7,400	177,600
	520	18	3,110	3,110	37,320
Total	58 rooms 520 crosscuts		33,910	39,560	766,920

RESULTS

Since the use of wooden roof bolts has been adopted in the Stony Point mine, 39,560 linear feet and 766,920 square feet of roof in rooms have been supported. There have been two failures in 9 months. The tonnage per face man has been approximately 40 tons a shift, the same as when steel roof bolts were used. When the difference in cost between wooden and steel bolts is considered, a saving of $27,128.00 in 9-months is indicated by the use of wooden roof bolts.

CONCLUSIONS

In view of the facts that this company has achieved virtually the same success with conventional timbering, steel roof bolts, and wooden roof bolts under the same roof conditions, and that this roof will not stand without some form of roof support, it may be desirable for operating people to make controlled studies of this method of support in localities where roof conditions appear to be similar. The fact that the cost of material is so much less than for other forms of roof support should make such experiments with wooden roof bolts attractive.